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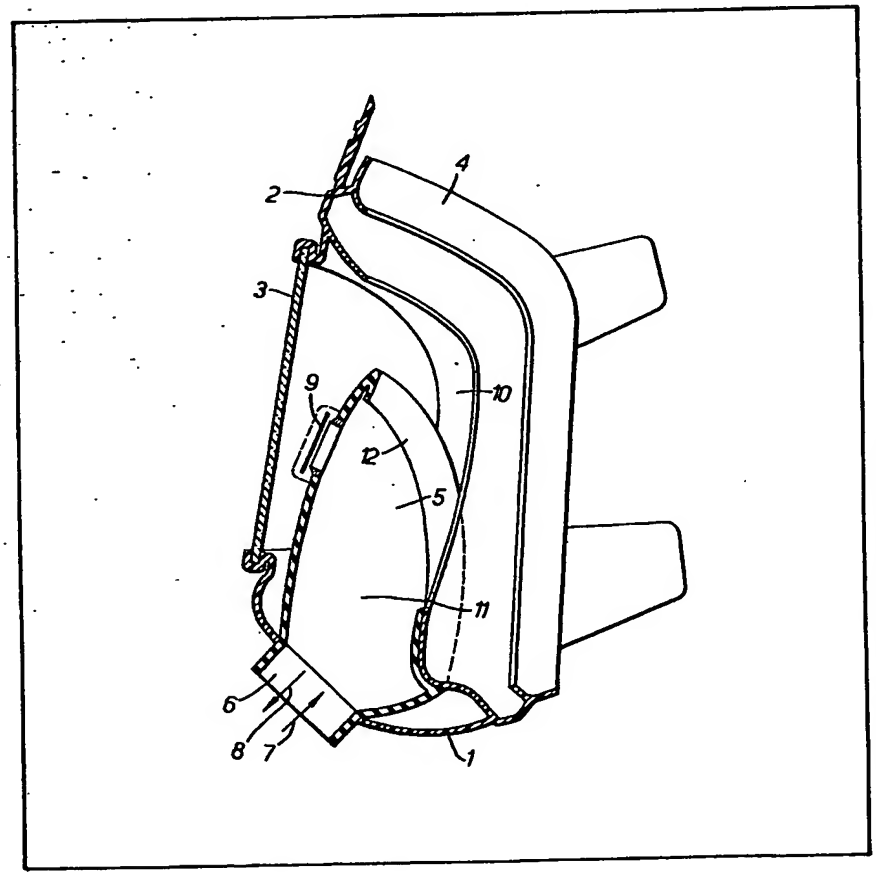
(54) Respiratory mask system

(57) A respiratory mask system has a main mask 1 and an inner half mask 5. A non-return valve 9 permits respiratory gas to flow only from the half mask 5 to a space 10. Thus, during exhalation, the space 10 is charged to a super-atmospheric pressure and this pressure prevents infiltration of the surrounding atmosphere into the main mask 1. As there is no permanent open connection between a respiratory gas circuit and the space, large losses of respiratory gas due to leaks should not occur.



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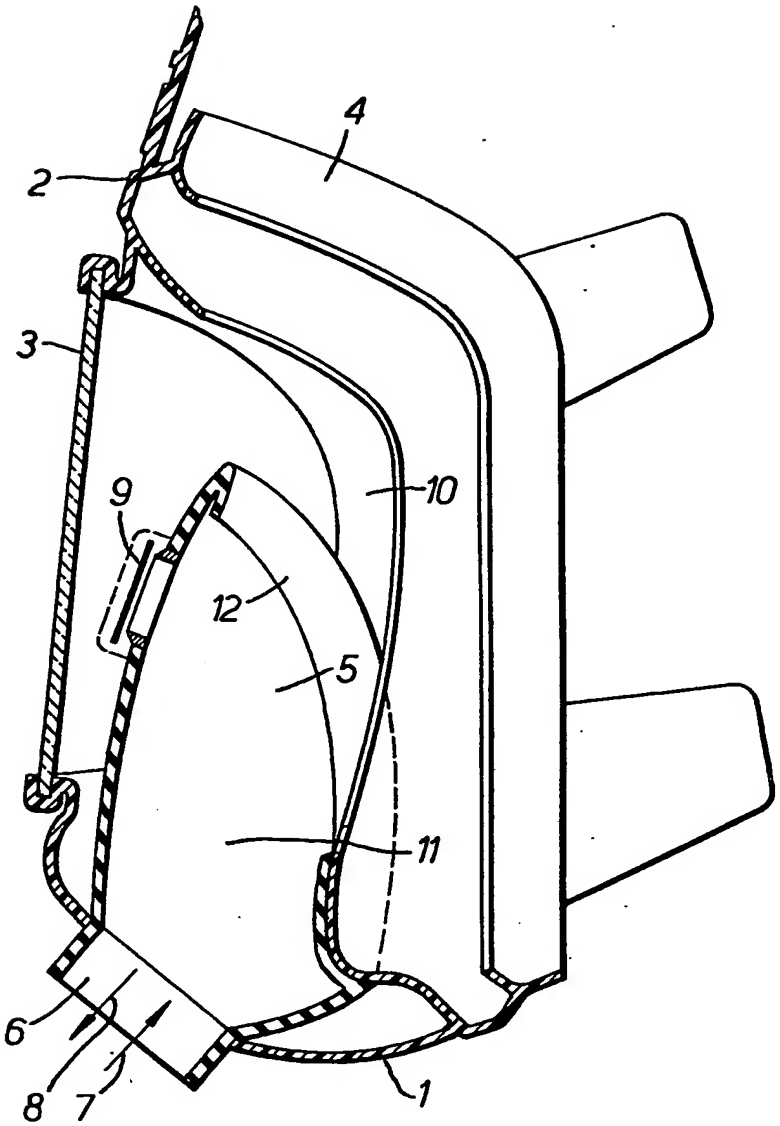

SPECIFICATION

Respiratory mask system

The invention relates to a respiratory mask system, and to a protective respiratory apparatus provided with such a respiratory mask system.

A known problem with protective respiratory devices is the need for tight contact of components of the respiratory device against the wearer of the device to prevent leaks. The surest respiratory contact is provided by a mouth-piece. However, a mouth piece is not always pleasant to wear and requires a corresponding discipline on the part of the wearer of the device. Today a full mask with an additional inner mask is predominantly used. Leakage between a mask sealing frame of the respiratory mask and the facial skin depends essentially on a fall in pressure between the surrounding atmosphere and the mask interior area. In all events, air from the surrounding atmosphere must be prevented from entering in through the mask sealing.

A known respiratory protective mask with double sealing rim is disclosed in Swiss Patent Specification 473 592. This mask has means for passing exhaled air through the area between both sealing rims. In this construction, the double sealing rim results from the sealing rim on the full mask and the sealing rim on the inerior mask, which also covers the whole face. Inhalation occurs through a connecting piece directly into the interior mask. The exhalation occurs through a valve, which only opens in the exhalation direction in a wall of the interior mask, through the space between the two masks, either through a further valve device directly towards the exterior or back into the respiratory circuit. Thus a small super-atmospheric pressure builds up in the space so that with a connection to a respiratory circulatory device, circulatory air can flow out through possible leaks in the sealing rim of the external mask to the exterior. That may lead under certain circumstances to a considerably shortening of the utilisation time, as this amount of outflow must be replaced from the relatively small oxygen supply of the device.

Another protective mask is disclosed in German Patent Specification 462 696. This protective mask comprises a full mask, and an internal auxiliary mask which is only rigidly fixed at the inlet and outlet ports, and which only covers the nose and the mouth. The internal mask is provided with a sealing chin support and a sealing rim in such a way that a good layout and sealing should result. With good sealing, the clearance volume or space in the main mask should be kept as small as possible. The clearance volume, i.e., the space between the main mask and the interior mask, is closed off by a tight interior mask from the respiratory circuit. The tightness necessary for shutting-off is not achieved however. The pressure differences arising during inhalation and exhalation, i.e., also a sub-atmospheric pressure, can obtain at the sealing rim of the full mask.

Thus the danger of infiltration of outside air does exit here.

According to the present invention there is provided a respiratory mask system comprising a main mask, a half mask within the main mask, a duct providing communication for respiratory gas between the interior of the half mask and the exterior of the main mask, and at least one non-return valve which only permits gas to flow from the half mask into a space between the half mask and the main mask thereby tending to maintain, in use, a superatmospheric pressure in said space.

The respiratory mask can include two or more non-return valves.

In a mask system according to the present invention, a super-atmospheric pressure, at the height of the exhalation resistance, is built up in the space between the masks by the exhaled air during an exhalation phase. This pressure then decreases again slowly towards "nil", during the following inhalation phase as a result of leaks into the inner half mask, since, depending on the shape of the face, (increasingly) larger leaks arise around the internal mask than those around the sealing frame of the main mask. During the following exhalation phase, the pressure in the space rises again. With this arrangement, under normal conditions no air can escape into the outside atmosphere around the external sealing frame, but in case of a leakage no outside atmosphere should leak into the mask.

The half mask can be provided with a sealing lip and the non-return valve can be provided by the sealing lip.

The present invention also provides a protective respiratory apparatus with a closed respiratory gas circuit, which includes a respiratory mask system as just defined, the arrangement being such that, in use, during exhalation, the or each non-return valve opens so that respiratory gas flows into said space in dependence upon the exhalation resistance of the respiratory apparatus.

For a better understanding of the present invention and to show more clearly how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawing which shows a vertical section through a respiratory mask system according to the present invention.

The respiratory mask system comprises a full or main mask 1, which has a mask body 2, a viewing window 3 and an external sealing frame 4.

Inside the main mask 1, there is an inner half mask 5. This half mask 5 is directly connected to an inlet and outlet duct 6 which is, or can be, connected to a respiratory device (not shown). Inhaled respiratory gas and exhaled respiratory gas flow through the duct 6 as indicated by the arrows 7 and 8 respectively.

In a wall of the inner half mask a non-return valve 9 is provided. The non-return valve 9 is one that can be easily opened and closed. It may be only lightly spring loaded or it may have no resilient biasing means. The non-return valve 9 only permits respiratory gas to flow from the interior 11 of the half mask 5 to a space or clearance volume 10 between the half mask 5 and the main mask 1. The half mask 5 has a sealing lip or rim 12.

During inhalation, as a sub-atmospheric pressure obtains in the half mask 5, the non-return valve 9 closes. During exhalation, a slight super-

atmospheric pressure arises in the interior 11 relative to the exterior due to the exhalation resistance of the respiratory device connected to the respiratory mask. As a result, the non-return valve 9 is thus opened, so that part of the exhaled air can flow into the mask space 10. Thus, during exhalation, the same super-atmospheric pressure is built up in the mask space 10 as in the interior 11 of the interior half mask 5. At the end of exhalation, the non-return valve 9 shuts again. With the sealing of the sealing frame 4 of the main mask 1 and the sealing rim 12 of the interior half mask 5, this super-atmospheric pressure is maintained in the mask space 10. If slight leakages occur it falls towards 'nil' during the following inhalation phase. During the next exhalation phase, gas again flows through the non-return valve 9 into the space 10 to return the pressure in the space 10 to a super-atmospheric pressure. The super-atmospheric pressure in the mask space 10 prevents, in all circumstances, the infiltration of the surrounding atmosphere by way of possible leakages between the sealing frame 4 and the surface of the wearer's face. It is expected that any leaks that occur from the space 10 will be from the space 10 into the iterior 11 of the inner half mask 5.

CLAIMS

1. A respiratory mask system comprising a main mask, a half mask within the main mask, a duct providing communication for respiratory gas between the interior of the half mask and the exterior of the main mask, and at least one non-return valve which only permits gas to flow from the half mask into a space between the half mask and the main mask thereby tending to maintain, in use, a super-atmospheric pressure in said space.

2. A respiratory mask system as claimed in claim 1, in which includes two or more of said non-return valves.

3. A respiratory mask system as claimed in claim 1, wherein the half mask includes a sealing lip for sealing the half mask to the user's face, which sealing lip is formed as a lip valve, the non-return valve being provided by said sealing lip.

4. A respiratory mask system substantially as hereinbefore described with reference to, and as shown in, the accompanying drawing.

5. A protective respiratory apparatus with a closed respiratory circuit, which includes a respiratory mask system as claimed in any preceding claim, the arrangement being such that, in use, during exhalation, the or each non-return valve opens so that respiratory gas flows into said space in dependence upon the exhalation resistance of the respiratory apparatus.

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